*Phytochemistry*, Vol. 27, No. 6, pp. 1795–1796, 1988.
Printed in Great Britain.

0031-9422/88 $3.00+0.00


# LABDANE DITERPENOIDS FROM *NOLANA FILIFOLIA*

JUAN A. GARBARINO, MARIA C. CHAMY, MARISA PIOVANO and VICENTE GAMBARO

Departamento de Química, Facultad de Ciencia, Universidad Federico Santa María, Casilla 110-V, Valparaíso, Chile

(*Revised received* 7 *October* 1987)

**Key Word Index**—*Nolana filifolia*; Nolanaceae; diterpenes, new labdane derivatives.

**Abstract**—Two new labdane diterpenes, 2β-acetoxylabda-8(17),13*E*-dien-15-oic acid and 2β-acetoxylabda-8(17),13*Z*-dien-15-oic acid, were isolated from the aerial parts of *Nolana filifolia*. The structure of the new compounds were elucidated by spectroscopic analysis of their methyl ester derivatives.

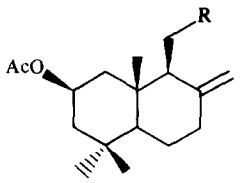
## INTRODUCTION

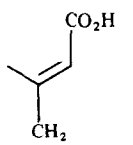
In a continuation of our work on the terpenoids occurring in plants of the Nolanaceae family [1], we have studied the diterpenoids isolated from *Nolana filifolia*, another member of the *Alona* section which is characterized by resinous specimens growing in Chile [2]. This paper describes the isolation and structure elucidation of two new labdane diterpenoids (**1** and **2**) from this plant.

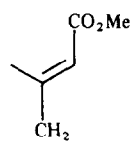
## RESULTS AND DISCUSSION

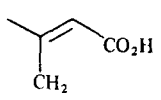
Compound **1**, purified and characterized as its methyl ester derivative, **1a** ($C_{23}H_{36}O_4$, $[M]^+$ at *m/z* 376) showed bands for acetoxy, α,β-unsaturated ester and exomethylene groups in the IR spectrum and gave a typical $^1H$ NMR spectrum for a labda-8(17), 13*E*-diene skeleton (δ 4.97, H-17; 4.60, H-17′; 5.72, H-14; and 2.17, Me-16) with a secondary acetoxyl group (δ 5.22, *quin*, $J=4.0$ Hz, H-2α; 2.05, *s*, acetyl). The spectrum also showed a three-proton singlet at δ 3.70 corresponding to a carbomethoxyl group, and three methyl singlets at δ 0.98, 0.92 and 0.88 were assigned to the Me-18, Me-19 and Me-20 of **1a**, respectively. Furthermore, the C-2 β-position for the acetoxyl group was deduced from the splitting (*quin*) and coupling constant values ($J=4.0$ Hz) of its geminal proton (α-orientation) in the $^1H$ NMR spectrum of **1a**. The assignments of the $^{13}C$ NMR spectral signals of **1a** (Table 1), made on the basis of the observed multiplicities (SFORD) and by comparison with reported $^{13}C$ NMR spectral data of related compounds [1,3] confirmed all the above results and defined the proposed structure as methyl 2β-acetoxylabda-8(17),13*E*-dien-15-oate.

Compound **2** was also purified and characterized as its methyl ester derivative **2a**. Comparison of the $^1H$ NMR spectrum of **2a** with that of **1a** showed no differences for the skeletal proton signals and only differed in the signals




**1** R = 


**1a** R = 


**2** R = 

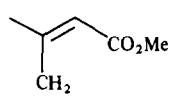

**2a** R = 


Table 1. $^{13}C$ NMR spectral data of compounds **1a** and **2a** ($CDCl_3$, TMS, SFORD)

| C | **1a** | **2a** |
|---|---|---|
| 1 | 41.6 | 41.5 |
| 2 | 70.4 | 70.6 |
| 3 | 43.2 | 43.3 |
| 4 | 32.7 | 32.7 |
| 5 | 54.0 | 54.1 |
| 6 | 24.0 | 24.0 |
| 7 | 37.9 | 38.0 |
| 8 | 147.2 | 147.3 |
| 9 | 56.5 | 57.5 |
| 10 | 38.9 | 38.9 |
| 11 | 21.7 | 22.4 |
| 12 | 39.6 | 32.5 |
| 13 | 160.5 | 160.6 |
| 14 | 114.9 | 115.6 |
| 15 | 167.0 | 166.5 |
| 16 | 18.7 | 25.2 |
| 17 | 107.2 | 107.3 |
| 18 | 33.6 | 33.7 |
| 19 | 23.4 | 23.3 |
| 20 | 15.9 | 15.8 |
| COOMe | 50.6 | 50.6 |
| MeCO | 170.2 | 170.3 |
| MeCO | 21.4 | 21.4 |

due to the side chain. As could be deduced from the $^1$H NMR spectrum, **2a** was a labdane with a *Z*-configuration double bond ($\delta$ 5.63, H-14; 4.95, H-17; 4.70, H-17′ and 1.90, Me-16) [1,4]. The $^{13}$C NMR spectrum of **2a** (Table 1) confirmed this point. In fact, the signals due to C-12, C-13, C-14, C-15, C-16 and the methoxyl group of methyl labda-8(17), 13*Z*-dien-15-oate [3], appeared at very similar positions to those in the spectrum of **2a**. The other carbon resonances remained almost unshifted compared with those of **1a**, leading to the assignment of the structure of **2a** as methyl 2$\beta$-acetoxylabda-8(17),13*Z*-dien-15-oate.

The absolute configuration of these new compounds was not determined. The co-occurrence of the new diterpenoids in the original extract from *N. filifolia* suggests that one of them is derived from the other by an enzyme catalysed isomerization reaction.

## EXPERIMENTAL

$^1$H NMR: 60 MHz, $CDCl_3$, TMS; $^{13}$C NMR: 100 MHz; IR: $CHCl_3$ or KBr pellets; mps: uncorr; MS: direct inlet, 70 eV. *Nolana filifolia* (Hook et Arn) Johnston, was collected in Cuesta Buenos Aires, IV Región, Chile, in Sept. 1986. A voucher specimen is deposited at Universidad Federico Santa María.

The air-dried aerial parts (400 g) of *N. filifolia* were extracted at room temp. with petrol for 6 hr affording 21 g of a syrup. This crude material (5 g) was chromatographed on a silica gel column (200 g) and eluted with mixtures of petrol and EtOAc of increasing polarity. Fractions of 50 ml were collected and combined (based upon TLC monitoring) to yield a mixture containing compound **1** and a mixture containing compound **2**. Both mixtures, named fractions A and B, respectively, were treated separately with ethereal $CH_2N_2$.

Fraction A (980 mg) was rechromatographed on a silica gel column (80 g, $HF_{254}$ for TLC) eluted with petrol–EtOAc 4:1 yielding pure **1a** (330 mg) and a mixture of **1a** and **2a**. Fraction B (1.4 g) was rechromatographed on a silica gel column (100 g, $HF_{254}$ for TLC) eluted with petrol–EtOAc 3:1 yielding pure **1a** (45 mg), a mixture of **1a** and **2a** and finally pure **2a** (420 mg).

*Methyl 2β-acetoxylabda-8(17), 13E-dien-15-oate* (**1a**). Amorphous powder (petrol–EtOAc); $[\alpha]_D^{25}$ −20.10 ($CHCl_3$; *c* 1.50). IR $\nu_{max}^{CHCl_3}$ cm$^{-1}$: 3070, 2960–2840, 1740, 1700, 1640, 1440, 1380, 1375, 1250, 1170, 1040, 895; $^1$H NMR (60 MHz); $\delta$ 5.72 (1H, *br s*, H-14), 5.22 (1H, *quin*, $J$ = 4.0 Hz, H-2$\alpha$), 4.97 (1H, *br s*, H-17), 4.60 (1H, *br s*, H-17′), 3.70 (3H, *s*, COO*Me*), 2.17 (3H, *d*, $J$ = 1.5 Hz, Me−16), 2.05 (3H, *s*, OAc), 0.98 (3H, *s*, Me-18), 0.92 (3H, *s*, Me-19), 0.88 (3H, *s*, Me-20); $^{13}$C NMR: see Table 1; MS *m/z* (rel. int.): 376 [$C_{23}H_{36}O_4$, M]$^+$ (5), 344 [M−MeOH]$^+$ (5), 316 [M−HOAc]$^+$ (27.5), 301 [316−Me] (17.5), 203 (30), 135 (85), 43 (100).

*Methyl 2β-acetoxylabda-8(17), 13Z-dien-15-oate* (**2a**). Mp 101–103° (petrol–EtOAc). $[\alpha]_D^{25}$ −13.5 ($CHCl_3$; *c* 1.11). IR $\nu_{max}^{KBr}$ cm$^{-1}$: 3060, 2940–2840, 1740, 1705, 1640, 1440, 1390, 1375, 1260, 1170, 1030, 900; $^1$H NMR (60 MHz): $\delta$ 5.63 (1 H, *br s*, H-14), 5.17 (1H, *quin*, $J$ = 4.0 Hz, H−2$\alpha$), 4.95 (1H, *br s*, H-17), 4.70 (1H, *br s*, H-17′), 3.67 (3H, *s*, COOMe), 2.02 (3H, *s*, OAc), 1.90 (3H, *d*, $J$, = 1.5 Hz, Me−16), 0.98 (3H, *s*, Me-18), 0.92 (3H, *s*, Me-19), 0.90 (3H, *s*, Me-20); $^{13}$C NMR: see Table 1; Ms *m/z* (rel. int): 376 [$C_{23}H_{36}O_4$, M]$^+$ (2. 8), 344 [M−MeOH]$^+$ (1.1), 318 (27.4), 303 (2.5), 203 (18.9), 175 (20.3), 135 (100), 107 (45.3), 93 (45.3), 43 (92.5), 41 (40).

*Acknowledgements*—We are grateful to Dr Aldo Mesa for the identification of plant material, Dr Boris Didyk, Refinería de Petróleo, Concón, Chile, for recording the mass spectra and Miss Cecilia Miranda for technical assistance. This research was supported by a grant (No. 871303) from DGDCYT, Universidad Federico Santa María.

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